



Plastic Waste Management

11.1 Plastics Waste: Environmental Issues and Challenges

The quantum of solid waste is ever increasing due to increase in population, developmental activities, changes in life style, and socio-economic conditions, Plastics waste is a significant portion of the total municipal solid waste (MSW). It is estimated that approximately 10 thousand tons per day (TPD) of plastics waste is generated i.e. 9% of 1.20 lacs TPD of MSW in the country. The plastics waste constitutes two major category of plastics; (i) Thermoplastics and (ii) Thermoset plastics. Thermoplastics, constitutes 80% and thermoset constitutes approximately 20% of total post-consumer plastics waste generated in India. The Thermoplastics are recyclable plastics which include; Polyethylene Terephthalate (PET), Low Density Poly Ethylene (LDPE), Poly Vinyl Chloride(PVC), High Density Poly Ethylene (HDPE), Polypropylene(PP), Polystyrene (PS) etc. However, thermoset plastics contains alkyd, epoxy, ester, melamine formaldehyde, phenolic formaldehyde, silicon, urea formaldehyde, polyurethane, metalised and multilayer plastics etc. The environmental hazards due to mismanagement of plastics waste include the following aspects:

- Littered plastics spoils beauty of the city and choke drains and make important public places filthy;
- Garbage containing plastics, when burnt may cause air pollution by emitting polluting gases;
- Garbage mixed with plastics interferes in waste processing facilities and may also cause problems in landfill operations;
- Recycling industries operating in non-conforming areas are posing unhygienic problems to the environment.

11.2 Main Features of the Plastics Manufacture and Usage (Amendment) Rules, 2003

Regulation of plastics waste, particularly manufacture and use of recycled plastics carry bags and containers is being regulated in the country as per "Recycled Plastics Manufacture and Usage Rules, 1999 and as amended in 2003. According to these Rules:

- No person shall manufacture, stock, distribute or sell carry bags made of virgin or recycled plastic bags which are less than 8 x 12 inches in

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size and having thickness less than 20 microns.

- › No vendor shall use carry bags/containers made of recycled plastics for storing, carrying, dispensing or packaging of food stuffs;
- › Carry bags and containers made of recycled plastic and used for purposes other than storing and packaging food stuffs shall be manufactured using pigments and colorants as per IS 9833:1981 entitled "List of pigments and colorants for use in plastics in contact with food stuffs, pharmaceuticals and drinking water"
- › Recycling of plastics shall be undertaken strictly in accordance with the Bureau of Indian Standard specification: IS 14534:1998 entitled "The Guidelines for Recycling of Plastics"
- › Manufacturers of recycled plastic carry bags having printing facilities shall code/mark carry bags and containers as per Bureau of Indian Standard specification: IS 14534:1998 (The Guidelines for Recycling of Plastics).
- › No person shall manufacture carry bags or containers irrespective of its size or weight unless the occupier of the unit has registered the unit with respective SPCB/PCC prior to the commencement of production.
- › The prescribed authority for enforcement of the provisions of these rules related to manufacturing and recycling is SPCB in respect of States and the PCC in Union Territories and for relating to use, collection, segregation, transportation and disposal shall be the District Collector/ Deputy Commissioner of the concerned district

11.3 Options for Plastic Waste Management

■ Recycling of plastics through environmentally sound manner:

Recycling of plastics should be carried in such a manner to minimize the pollution during the process and as a result to enhance the efficiency of the process and conserve the energy. Plastics recycling technologies have been historically divided into four general types -primary, secondary, tertiary and quaternary.

Primary recycling involves processing of a waste/scrap into a product with characteristics similar to those of original product.

Secondary recycling involves processing of waste/scrap plastics into materials that have characteristics different from those of original plastics product.

Tertiary recycling involves the production of basic chemicals and fuels from plastics waste/scrap as part of the municipal waste stream or as a segregated waste.

Quaternary recycling retrieves the energy content of waste/scrap plastics by burning / incineration. This process is not in use in India.

■ Steps Involved in the Recycling Process

Selection: The recyclers / reprocessors have to select the waste / scrap which are suitable for recycling /reprocessing.

Segregation: The plastics waste shall be segregated as per the Codes 1-7 mentioned in the BIS guidelines (IS:14534:1998).

Processing: After selection and segregation of the pre-consumer waste (factory waste) shall be directly recycled. The post consumer waste (used plastic waste) shall be washed, shredded, agglomerated, extruded and granulated

11.4 Polymer Coated Bitumen Road

The CPCB has undertaken a project in collaboration with Thiagarajar College of Engineering Madurai to evaluate the performance of polymer coated built roads laid during 2002-2006 in different cities.

The observations are as below:

- › The coating of plastics over aggregate improves Impact, Los Angeles Abrasion and Crushing Value with the increase in the percentage of plastics.
- › The extracted bitumen showed almost near value for Marshall stability. The entire road was having good skid resistance and texture values.
- › All the stretches in the roads have been found reasonably strong.
- › The unevenness index values of these roads are nearly 3000 mm/km, which indicate a good surface evenness.
- › The plastic tar roads have not developed any potholes, rutting, raveling or edge flaw, even though these roads are more than four years of age.
- › Polymer coated aggregate bitumen mix performs well compared to polymer modified bitumen mix.
- › Higher percentage of polymer coating improves the binding strength of the mix.
- › Foam plastics have better binding values.

11.5 Plastics waste disposal through Plasma Pyrolysis Technology (PPT)

Plasma Pyrolysis is a state of the art technology, which integrates the thermo-chemical properties of plasma with the pyrolysis process. The intense and versatile heat generation capabilities of PPT enable it to dispose off all types of plastic wastes including polymeric, biomedical and hazardous waste in a safe and reliable manner.

Plasma Pyrolysis Technology

In plasma pyrolysis, firstly the plastics waste is fed into the primary chamber at 8500C through a feeder. The waste material dissociates into carbon monoxide, hydrogen, methane, higher hydrocarbons etc. Induced draft fan drains the pyrolysis gases as well as plastics waste into the secondary chamber, where these gases are combusted in the presence of excess air. The inflammable gases are ignited with high voltage spark. The secondary chamber temperature is maintained at around 10500 C. The hydrocarbon, carbon monoxide and hydrogen are combusted into safe carbon dioxide and water. The process conditions are maintained so that it eliminates the possibility of formation of toxic dioxins and furans molecules (in case of chlorinated waste). The conversion of organic waste into non toxic gases (CO₂, H₂O) is more than 99% . The

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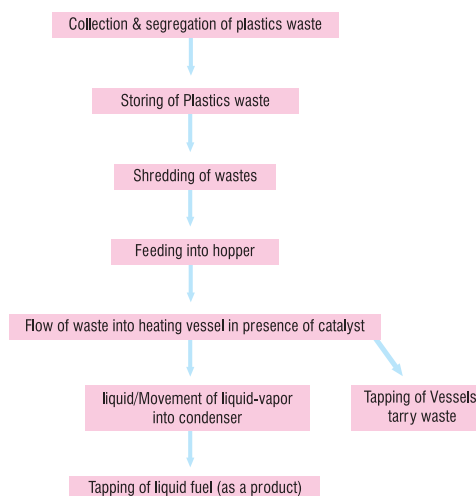


extreme conditions of Plasma kill stable bacteria such as *Bacillus stereo-thermophilus* and *Bacillus subtilis* immediately. Segregation of the waste is not necessary, as very high temperatures ensure treatment of all types of waste without discrimination.

The CPCB has initiated the study in association with Facilitation Centre for Industrial Plasma Technologies (FCIPT), Institute of Plasma Research (IPR) The objectives of the study are to conduct performance study of the PPT on 15 kg/hr prototype demonstration system developed by FCIPT/ IPR for proper disposal of plastics waste and also monitor air quality parameters e.g. suspended particulate matter (SPM), carbon monoxide (CO), hydrocarbons (HC), benzene, dioxins, furans etc. with regards to gaseous emissions. CPCB also proposes to undertake study on safe disposal of plastics waste using higher capacity (approx. 50 kg/hr) plasma pyrolysis system as in future and may set up prototype plasma pyrolysis plant on demonstration basis (15 kg/hr waste disposal capacity) at specific locations (hilly and pilgrimage) in consultation with State Government.

11.6 Conversion of Plastics waste into Liquid Fuel

A research-cum-demonstration plant was set up at Nagpur, Maharashtra for conversion of waste plastics into liquid fuel. The process adopted is based on random de-polymerization of waste plastics into liquid fuel in presence of a catalyst. The entire process is undertaken in closed reactor vessel followed by condensation, if required. Waste plastics while heating upto 2700 C to 3000 C convert into liquid-vapour state, which is collected in condensation chamber in the form of liquid fuel while the tarry liquid waste is topped-down from the heating reactor vessel. The organic gas is generated which is vented due to lack of storage facility. However, the gas can be used in dual fuel diesel-generator set for generation of electricity. The process includes the steps shown ahead:



Environment related observations during the process

- › There are no liquid industrial effluents and no floor washings as it is a dry process.
- › There are no organized stack and process emissions.
- › Odour of volatile organics has been experienced in the processing area due to some leakages or lack of proper sealing
- › Absolute conversion of liquid-vapour was not possible into liquid, some portion of gas (about 20%) is connected to the generator. However, the process will be improved in full-scale plant.
- › PVC plastics waste is not used and if used, it was less than 1%. In case PVC is used, the chlorine can be converted into hydrochloric acid as a by-product.
- › The charcoal (charcoal is formed due to tapping of tarry waste) generated during the process has been analysed and contain heavy metals, poly aromatic hydrocarbon (PAH) which appears to be hazardous in nature. The source of metals in charcoal could be due to the presence of additives in plastics and due to multilayer and laminated plastics.
- › Monitoring of process fugitive emissions in the work area as well as emissions from the engines/diesel generator sets is necessarily required (where this liquid fuel is used) for various parameters such as CO, HCl, Styrene, Benzene, VOCs.

Environmentally degradable polyolefin films are those materials that degrade under conditions of composting

11.7 Biodegradable Plastics

The environmentally degradable polyolefin films are defined as those materials that contain degradation process of polyolefin article (bag/film/sheet) under conditions of composting. Often queries are raised regarding biodegradability of plastics but clear-cut answer is not available about the biodegradability of plastics. In view of above, CPCB has initiated a study in collaboration with Central Institute of Plastics Engineering and Technology (CIPET) to establish the biodegradability and compostability (e.g. fragmentation rate, degradation rate and safety) of polymeric material available in India and abroad. The study will include:

- › Inventorisation and assessment of the manufacturing status of biodegradable plastics in India particularly with reference to processing technologies and the environmental issues.
- › Establishment of the degradation rate (change in chemical structure, decrease in mechanical strength, fragmentation or weight loss) of the polymeric material or plastics material under laboratory scale composting conditions
- › Finding out self-life and its impact on environment (soil, water of plastics with reference to colour and additives, once it is disposed off)
- › Assessment of effects on foodstuffs with reference to natural colours and additives

the 1990s, the number of people in the world who are illiterate has increased from 1.1 billion to 1.2 billion (UNESCO 2003).

There are many reasons for this increase. One of the reasons is that the population of the world is growing rapidly. Another reason is that the number of people who are illiterate is increasing in many countries, especially in the developing world. This is because of the lack of access to education and the high cost of education.

There are many ways to reduce the number of illiterate people in the world. One way is to improve access to education. Another way is to reduce the cost of education. A third way is to provide training and education for illiterate people.

There are many organizations that are working to reduce the number of illiterate people in the world. One of these organizations is UNESCO. UNESCO is working to improve access to education and to reduce the cost of education. UNESCO is also providing training and education for illiterate people.

There are many other organizations that are working to reduce the number of illiterate people in the world. These organizations are working to improve access to education and to reduce the cost of education. They are also providing training and education for illiterate people.

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